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SURVEY NOTES

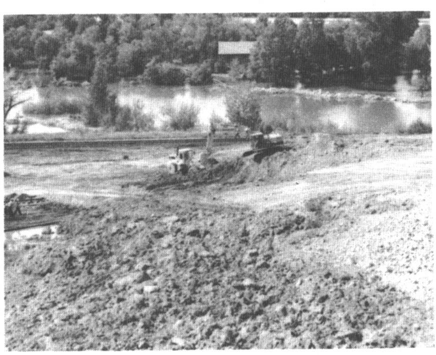
Vol. 15, No. 3 — Service to the State of Utah — August 1981

LANDSLIDE DERAILS MAIL TRAIN

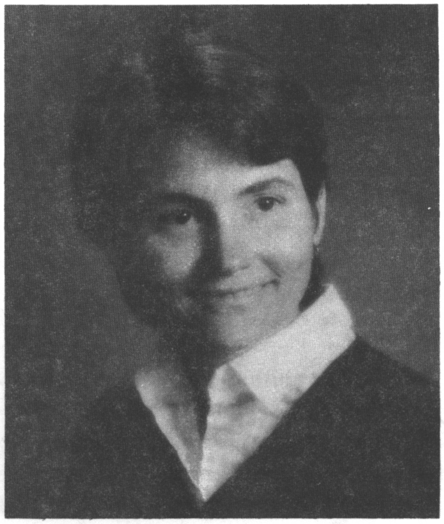
A major slope failure developed along the bluffs bordering the north bank of the Weber River west-northwest of Uintah, Utah on May 17, 1981 (see below). The rapidly moving slide derailed eight Union Pacific railroad cars. The toe of the slide came to rest in the Weber River, diverting the flow and flooding four homes in the immediate vicinity. As many as three Utah Power and Light Company transmission line towers were destroyed and 50 head of cattle were reported missing.

Bruce Kaliser, Chief Engineering Geologist, and staff geologists Harold Gill and Gary Christenson, examined the landslide on May 18. A scarp over 1,000 feet in length and up to 80 feet in height was exposed, the toe travelled a distance of approximately 1,000 feet. Fresh cracks were observed at the base of an older scarp immediately east

(continued on pg. 7, col. 3)



Crews clean up landslide that covers railroad tracks along near side of river, on right and causes flooding.



Genevieve Atwood

NEW DIRECTOR LOOKS AT UGMS

As the newly appointed director of the UGMS, I have been impressed by the caliber of the staff and also by the increasing importance of the Survey in meeting the needs of the State in these times of expanding demands for natural mineral resources.

The legislation that enacted the UGMS is relatively clear in defining the UGMS mission. The UGMS is to inventory all the mineral and geologic resources within Utah, to identify the geologic hazards of the state, to educate the public on geologic matters and to advise decision makers on issues of geologic importance.

The UGMS has proved that it is capable of responding to the challenge.

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NEW GEOLOGIC MAP OF UTAH IS HERE

The new geologic map of Utah, in full color, is off the press.

The map was compiled by Dr. Lehi F. Hintze, professor of Geology at Brigham Young University. Dr. Hintze was co-author of an earlier 1 : 250,-000 scale map of Utah, now out of print.

The new 1 : 500,000 scale map is the result of many years of effort, requiring the examination and compilation of perhaps a hundred geologic reports and maps of local areas. The new 36 by 35 inch map uses 35 different colors to identify the outcrop areas of different rock formations across the state.

A new feature to accompany the map is a second sheet that includes eight lithologic columns and seven geologic cross sections, all in full color.

The map is available at the UGMS Sales Office, 606 Black Hawk Way, Salt Lake City, Utah 84108, for $10.00 plus tax. To order by mail, add $2.00 for postage and mailing tube, and $.50 tax if ordered within Utah.

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THAR'S GOLD IN THEM THAR...

by Martha R. Smith
Mineral Information Specialist

Utah is experiencing a new gold rush. The high price of gold has brought renewed interest in the possibility of bringing back to life the old mining districts.

History

Gold is reported to have been found in Utah by the Mexicans around 1840; their mines have been located near Cedar City in Iron County and Kamas in Summit County. In 1863 gold was found with lead-silver ore in Bingham Canyon, and the next year a large placer deposit was found at the mouth of Bingham Canyon. After a few years the placer was virtually mined out, but at the same time people were scouring the near-by hills for gold. Many of these early prospectors had had experience in the California gold rush or in other mining districts and before long many thousands of claims had been filed, mostly on fissure veins, and many hundreds of mines had been started. Eventually these were either mined out and abandoned, or were consolidated, especially in the richer mining districts. Activity fluctuated with the price of metal, then as now.

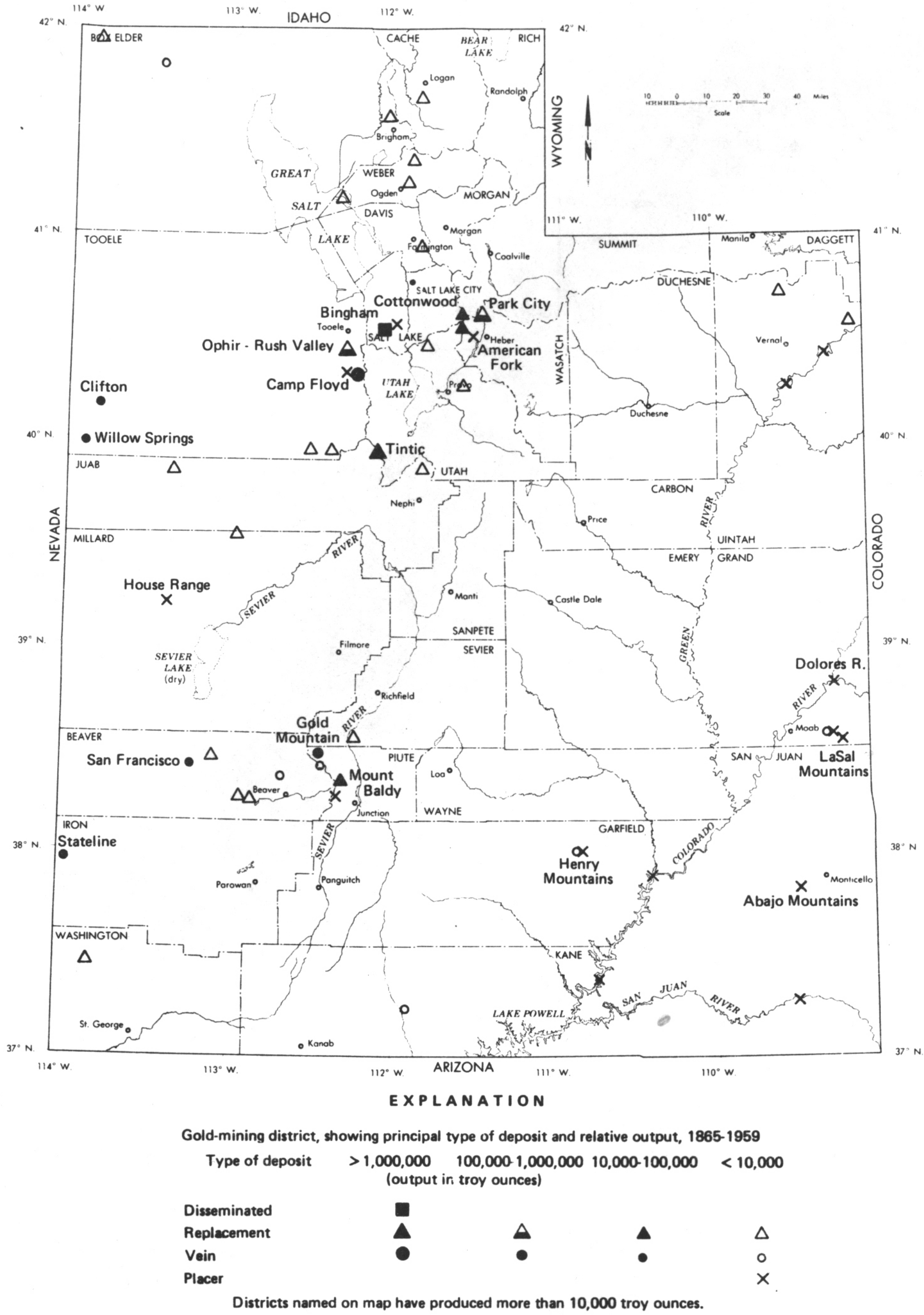


Figure 1. Areas in Utah which have produced gold mining districts.

During the depression of the 1930s the hills were again thoroughly prospected by miners, but very few were able to make a living at it. As a result of this intensive exploration the chances of finding a new near-surface deposit of any size today are almost non-existent.

Most gold mines were closed during World War II and, because the price of gold was fixed at a level less than the cost of recovering it, most mines remained closed. In spite of this, Utah has ranked second (1979) or third (1980) in gold production in the United States. Kennecott Minerals Corporation's Bingham Pit, in the Oquirrh Mountains, is not only the largest copper mine in the world, but produces most of Utah's gold (over 200,000 ounces a year) as a by-product of the copper. Several other mines have continued to produce gold in the Tintic and Marysvale districts (see figure 1 for locations of the districts), but as by-products of copper, lead and silver.

Today, after careful study, old lead-silver mines are being reopened in the Tintic, Park City, American Fork and other districts, and gold is recovered as a by-product. A little gold is also being produced from placers in the Henry Mountains and along the Colorado and San Juan Rivers in southeastern Utah.

Utah's Gold Deposits

In Utah, gold is found in two major kinds of deposits: primary or lode deposits, which include fissure veins, replacement bodies, and disseminated porphyry ores, and secondary or placer deposits.

(continued on pg. 3)

THAR'S GOLD

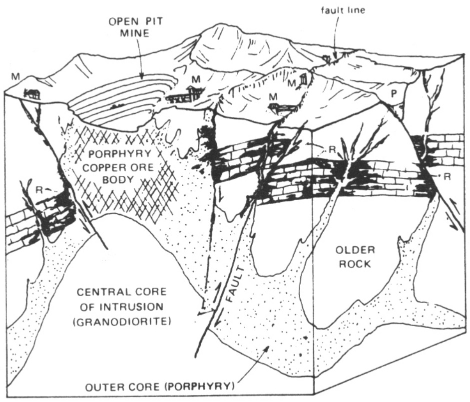
(continued from pg. 2)

Primary gold is found in or near bodies of granitic rock that have been intruded into the older rocks of the crust as molten material. As this molten mass moved upward, its outer part was chilled and formed a porphyritic shell (a rock with visible crystals scattered in a very finely crystalline groundmass) (figure 2). The interior core cooled more slowly; silicate minerals were precipitated from the melt to form a larger-grained granitic rock, and the heavier metals (such as iron, lead, copper, silver and gold) were concentrated in the residual fluids, with sulfur, quartz, and water. These metal-rich fluids precipitated quartz, metallic sulfides, and the gold in fractures and faults in the upper part of the solidifying mass or in the country rock around it, forming the *fissure vein* deposits.

Since fissure veins are largely quartz, they tend to be more resistant to erosion and to make prominent outcrops. The fissure veins are found in many kinds of rocks around the intrusions. Some are found in volcanic rocks, as at the State Line and Gold Mountain districts, some in sedimentary sandstones, shales, quartzites and limestones, as at Bingham, Tintic, Cottonwood, Park City, Clifton, and other districts. Some veins cut very old Precambrian rock, as at American Fork. At Park City, veins are also found in the intrusive rocks.

Where the molten mass pushed its way upward through limestones, acids in the residual fluids dissolved the limestone and it was in part replaced by the quartz and sulfide minerals, forming *replacement* ore bodies. Important replacement ores are found in the Tintic, Cottonwood, Ophir, Willow Springs, Mt. Baldy, San Francisco, and Park City districts.

High water pressures and chemical reactions in some intrusions may have caused the porphyry cap to be intensely shattered and altered. The quartz and metallic sulfides in the residual fluids are deposited along the tiny fractures in the cap to create a *disseminated porphyry* ore



M = mines (underground) on fissure veins or replacement ores.
P = placer deposit in stream gravel.
R = replacement ore in limestone.

Figure 2. Block diagram showing relationship of gold deposits to intrusion.

body, as at Bingham. This ore body is relatively low grade but is so large that, with mass-production methods, the metals can be profitably recovered. Utah has only one such deposit, but it is one of the largest in the world.

Oxidized and Sulfide Ores

The gold in the fissure vein, disseminated porphyry, and replacement bodies was usually deposited as tiny grains in the sulfides. The gold is normally invisible and its presence can only be determined by chemical or metallurgical tests. The U.S. Bureau of Mines Research Center in Salt Lake City will determine what metals are in an ore, and assayers, listed in the Yellow Pages of the telephone book, can determine the amount of gold and other metals.

Once the sulfide ores are in place, and this may take millions of years, those near the surface are subject to oxidation by weathering, erosion and groundwater. The sulfur in the minerals is replaced by the oxygen resulting in a concentration of the metals and freeing of the gold.

The early discoveries of rich gold-bearing fissure veins, as at Bingham, Tintic, Cottonwood, and Gold Hill, were such oxidized ores. They are found near the surface and the soft oxide minerals are not only enriched but are relatively easy to mine, to mill and to refine. The underlying sulfide ores are deeper, leaner, and require more costly methods of milling and smelting so that large deposits must be present to be economically valuable.

Placer Deposits

As erosion removes the enclosing rock, the free gold, which is chemically inert and not subject to combining with other elements, is washed downslope and concentrated in depressions in the bottom of the stream or in the sand and gravels. This is placer gold. Larger grains are easily recovered by panning (washing away the lighter sand and gravel, and concentrating the heavier minerals, including the gold).

As placer deposits are reworked by subsequent floods, the gold may be further concentrated, or it may be broken into smaller-sized grains and carried on down stream, to be eventually distributed in the fine muds and sands of river flood plains. Such gold is present in several Permian and Triassic formations in the Colorado Plateau, where there are huge tonnages averaging one to two dollars a ton (at 1981 prices), but the gold is so very fine that no one has found a practical way to recover it.

The only placer of any size in Utah was the one in Bingham Canyon, from which gold worth $1.5 million at 1900 prices was recovered. Some placer gold is being recovered in the Henry Mountains, in south central Utah, and a little along the Colorado and San Juan rivers. Most of this gold is very fine grained (flour gold) and is difficult to recover.

Since all of the known placer deposits in Utah have been worked and reworked by professional miners, there is very little chance today, of finding more than very small pockets of gold in Utah's streams.

Prospecting for gold

Today mining companies, large and small, are investing millions of dollars looking for large new gold-bearing de-

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THAR'S GOLD

(continued on pg. 3)

posits or extensions of known deposits. After making a systematic review of the geology of known productive areas, they obtain control of the land in the area of interest and make preliminary geophysical and geochemical surveys. These are followed by drilling to locate and block out ore bodies which may not be visible on the surface.

Few individuals have the resources for such a program, but many individuals are prospecting the mountains and streams of Utah, hoping to find what others have missed. Claims are being staked in record numbers (nearly 30 thousand were recorded in 1980).

Land Ownership

The first thing a prospector *must* do, after deciding on the area he wants to explore, is to find out who owns the land. About 67 percent of the land in Utah is administered by the Federal Government and is controlled by the Bureau of Land Management (BLM) or the U.S. Forest Service. Much of this land is open to prospecting, except for National Parks, National Monuments, Indian Reservations, military reservation, reclamation projects, wildlife refuges, or other withdrawn areas. The BLM has maps at its State and District Offices showing land ownership, and it can also provide information about locating and recording mineral claims. Most National Forest land is open, except watershed areas, but no digging or construction of dams or sluices is permitted. Check first with the local Forest Ranger for any regulations or restrictions.

On land owned by the State, including school sections, permission to prospect must be obtained from the Utah Division of State Lands. State and local parks are, of course, out of bounds. On private land, permission must be obtained from the owners.

Placer prospecting is permitted in and along streams on open Federal lands, but make sure the land is open—owners of private property and of claims take a dim view of trespassers. Permission is required on State land; navigable rivers and lakes are under the jurisdiction of the State. Permission is required for the use of gold dredges and vacuum gold-recovery devices.

Staking a claim

Once a mineral deposit has been found and the prospector has verified that it is not already owned or claimed, its location is marked with posts or monuments (piles of rocks) at each corner. A lode claim is 600 feet by 1500 feet, parallel to the vein or outcrop of the mineral deposit. A placer claim, on stream gravels along or in a stream, covers 20 acres. A location notice must be placed on one of the corner markers and, within 90 days, a copy of the notice must be filed with both the Recorders Office in the county in which the claim is located, and with the State Office of the Bureau of Land Management. The BLM has records of all claims and can verify the presence and status of any prior claims.

To maintain the claims the owner must perform at least $100 worth of work or improvements on each claim each year, and must file an affidavit of such work with both the County Recorder and the State Office of the BLM by the 31st of August of the year following the recordings of the claim, and each year thereafter.

A claim is valid only if a valuable mineral deposit has been discovered. The discovery must justify the expenditure of labor and money to develop it and present a reasonable expectation of making a profit. A claim can be bought or sold, but it is not permissible to build a residence or any other structure on a claim, except for the express purpose of working the claim. Before a claim may be worked, a permit must be obtained from the Utah Division of Oil, Gas and Mining.

Once located, an ore body should be mapped to determine its size and potential tonnage, and sampled to determine its potential value. This is best done by a geologist experienced in mineral appraisals. Mapping and sampling are valid work and improvement costs.

To maintain public land for future generations, only as much land may be disturbed as is essential to developing the mineral deposit, and such disturbance must be restored when the deposit is mined out.

Agencies to contact for further information:

Filing and registering claims, and the availability of Federal land for mineral prospecting:

U.S. Bureau of Land Management
University Club Bldg., 14th floor
136 East South Temple
Salt Lake City, Utah 84111
Phone: (801) 524-5330

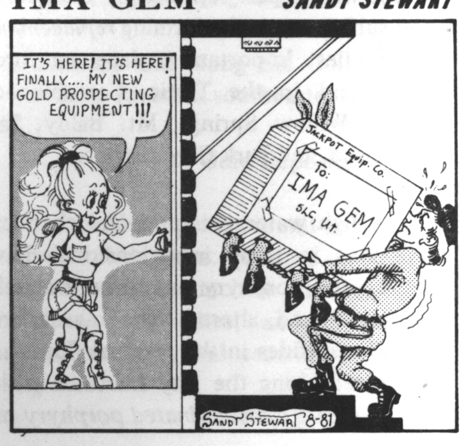
Prospecting and leasing mineral properties on State Land:

Utah Division of State Lands and Forestry
231 East 400 South
Salt Lake City, Utah 84111
Phone: (801) 533-5381

Information about prospecting on Forest Service Land:

U.S. Forest Service, Supervisors Office
125 South State Street
Salt Lake City, Utah 84111
Phone: (801) 524-5030

IMA GEM ***SANDY STEWART***



SIGHTS ON PUBLIC FACILITY SITES No. 6

Bruce N. Kaliser
Chief Engineering Geologist

PUBLIC HOUSING

Local government is increasingly becoming involved with providing public housing for senior citizens, low income residents and the handicapped. The most cost effective construction for this kind of housing appears to be high rise structures. In multistory residential complexes with high occupancy rates residents are frequently unaware of any risk they may be assuming from exposure to natural hazards. Consequently, the government entity responsible for the project must also assume responsibility for its siting.

Clearly, public housing should be sited outside of flood zones, fault "zones of deformation" and other zones of potential land deformation, including areas of potential landslides. Risk from rock fall and failing water impoundments should be considered and deflection devices constructed, if necessary to minimize such risk.

Soil dynamics characteristics of the site should be determined and buildings planned to make sure the dynamics of the structure are not in harmony with the soil, or the buildings will experience aggravated motion in the event of a moderate or greater intensity earthquake. In other words, structures of a certain height and type construction should be sited on terrain where the actual frequencies of vibratory waves are different from the building's frequency.

Another critical factor to be looked for, particularly in the Wasatch Front communities in Utah, is liquefaction susceptibility. If foundations for any high-rise structure must be placed in or above a susceptible soil horizon, proper foundation design (deep piles, for example) or other site remedial measures must be used, although site relocation to non-susceptible areas is preferable.

The possibility of flooding from a shallow groundwater regime must be considered before locating underground appurtenances such as furnace rooms and parking facilities.

Careful consideration of building sites can prevent many potential disasters from natural causes.

TAR SAND LEASING LAW PASSES HOUSE

A bill to open Federal acreage to leasing of tar sands has been passed by a 416 to 0 vote of the U.S. House of Representatives. The legislation will authorize issuance of a combined hydrocarbon lease in "designated tar sand areas" similar to the hydrocarbon lease that has been available on Utah state lands for almost two decades. The legislation was sponsored by Representatives Dan Marriott (Rep., UT) and James Santini (Dem., NV).

The Congressional action ended an impasse over definition of the substances covered by Federal oil and gas leases. This formed the basis of an administratively mandated moratorium on tar sand leasing that had existed since 1965.

CORRECTION NOTED IN THRUST BELT MAP

Several readers have pointed out that the map showing location of oil and gas fields in relation to principal thrust faults (Survey Notes, February 1981, p. 2, fig. 2) contains an error in the locations of the Painter Reservoir and Painter Reservoir, East fields in Uinta County, Wyoming. For readers who have saved that map and accompanying article, Painter Reservoir field is the large black oval immediately east and north of the city of Evanston and Painter Reservoir, East is the gas field immediately to the east of the oil field. The small gas field shown between the thrust faults 5 miles east-southeast of Painter Reservoir, East and labelled as such is a mistake and doesn't exist – at least, not yet.

MINERAL LOCATION SYSTEM

Information on more than 135,000 U.S. mineral locations – including active and abandoned mines, geothermal wells, smelters, and refineries – is now stored in the Bureau of Mines Mineral Industry Location System (MILS).

For each mineral location, MILS includes the name, map coordinates, mineral commodity, type of operation, and other relevant data. This information is available for mineral exploration, land use planning, and resource decision-making in areas near important mineral zones.

Data in the system are supplied in the form of clear plastic map overlays designed for use with quadrangle maps issued by the U.S. Geological Survey. The overlays have mineral locations accurately plotted on them by computer. Each overlay is accompanied by a computer printout that gives details on each mineral location, including a bibliography, which refers the user to other sources of information, and cross references for other information systems in the Bureau, the Mine Safety and Health Administration, and the U.S. Geological Survey.

For more information contact:

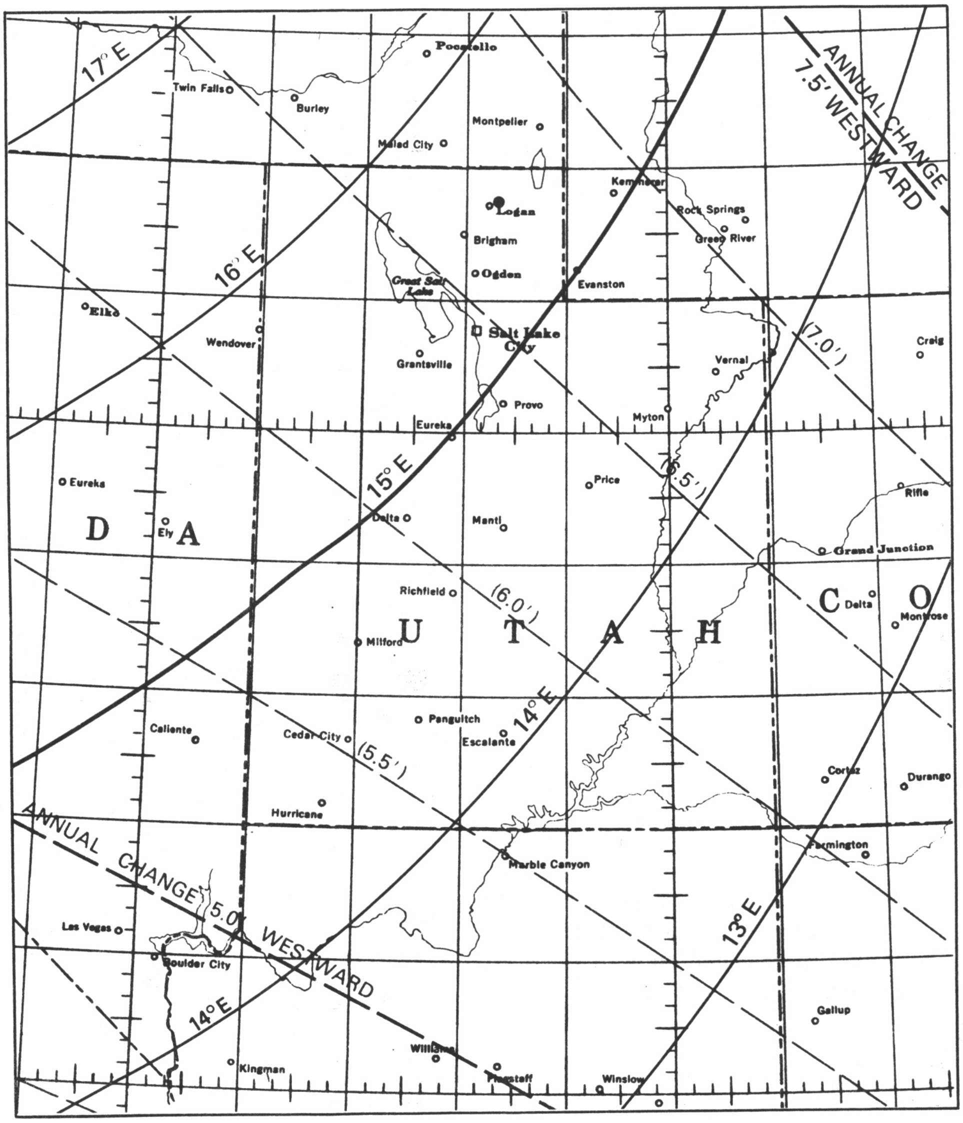
Intermountain Field Operations Center
Bureau of Mines
Building 20, Federal Center
Denver, Colo. 80225
(303)234-4161

OIL, GAS, COAL BRING LEASE MONEY TO STATE

Sale of 129 oil and gas leases by the Utah Division of State Lands on August 31 brought in a total of $5,862,-975 in bonus bids. Two previous lease sales brought in another $2.07 million.

BLM's competitive lease sale of 5 coal tracts in Carbon and Emery counties drew high bids totalling about $14 million. Half of this goes to the State. Five more tracts will be offered in early 1982.

MAGNETIC DECLINATION MAP ISSUED BY USGS



Magnetic declination (compass variation) for Utah and surrounding states, January 1980, with isoporic lines indicating annual change westward (from U.S. Geological Survey Map 1-1283).

A map showing magnetic declination and annual rate of change for the United States, Alaska and Hawaii has been issued by the U.S. Geological Survey.

The map shows magnetic declination (also called campass variation), the angle between true north and the direction in which a magnetic compass points. Also shown are isoporic lines, lines of equal annual change of declination.

Declination in 1980 varied across Utah from 16°20′ at the northwest corner to 13°10′ the Four Corners. Salt Lake City declination was 15°15′ and St. George 14°30′. Declination is changing 5.5′ annually westward in the Cedar City area and 6.5′ annually westward in Salt Lake City.

Map 1-1283, Magnetic Declination in the United States, Epoch 1980, by E. B. Fabiano and N. W. Peddie, may be obtained from the U.S.G.S. Public Inquiries Office at the Federal Building. It replaces Map 1-911 dated 1975.

MUD SLIDE IN MEMORY GROVE

Salt Lake City's Memory Grove Park was partially over-run with cobbles, finer sediment and water in May and June as two slope failures on the east side of City Creek Canyon sent debris flowing down steep slopes to the serene setting below. Water from spring rainfall and a severed pipe aggravated the debris and erosion problem downslope.

According to Bruce N. Kaliser, UGMS chief engineering geologist, one of the slides was *translational* with a failure plane more or less parallel to the slope and the second was *rotational* with an arcuate failure plane of variable depth below the original surface. Kaliser believes that all earth materials involved in the slope failure were man-placed fill, placed many years ago. He says that this points out the need to control and monitor fill slopes, particularly in urban environments.

One neighboring residence was affected by soil movement at the crown of the slope. Kaliser notes that there is a risk of considerably greater displacements in the event of a moderate or greater magnitude earthquake.

SURVEY GEOLOGISTS SERVE AS ADJUNCT PROFESSORS

Two UGMS staff members have been notified by the Academic Affairs Committee that they have been reappointed as Adjunct Professors at the University of Utah. Howard Ritzma, Assistant Director and Chief of the Petroleum Section, is Adjunct Professor of Fuels Engineering and Bruce Kaliser, Chief Engineering Geologist, is Adjunct Professor of Applied Geomorphology.

Dr. Hellmut Doelling, Chief of the Economic Geology Section, also gives lectures at the University of Utah, at Weber State and at BYU on coal geology and other geologic subjects.

NEW PUBLICATIONS

Utah Mineral Industry Operator Directory, 1981, Compiled by Martha R. Smith, UGMS Circular 70. $3.00 over-the-counter; $3.75 by mail, prepaid. A listing of active mineral operations in Utah, giving names and addresses of operators, names and locations of properties and, where available, metals, oil and gas, and uranium, they are also listed by county.

Utah Coal Studies II, (two papers); UGMS Special Studies 54; $3.00 over-the-counter; $3.75 by mail, prepaid. These are:

(1) *Coal Drilling, North Horn Mountain, East Mountain Areas, Wasatch Plateau, Utah,* by Archie D. Smith, 1981, 31 p, 6 fig, 16 tables. Eighteen holes were drilled through the lower Blackhawk Formation in northwestern Emery County. Both the Blind Canyon and Hiawatha coal zones were tested; lithology and ultimate analyse for the minable coal in each hole are given. Reserve calculations show a total in-place indicated and inferred tonnage of nearly 313 million short tons of coal, of which more than 133 million is considered recoverable.

(2) *Geologic evaluation of a Central Utah coal property, Wasatch Plateau, Utah,* by John M. Mercier and Thomas W. Lloyd, 1981, 11p, 8 fig, 2 tables. A multi-seam coal property containing five active mines about 25 miles south of Price, Utah, was intensely studied and the collected data successfully used for planning and development of the underground mines. Data from detailed mapping, sampling, monitoring in mines, interpretation of depositional features, drilling, and outcrops are used to predict the location of channels, rolling of seams, hydrologic problems, unstable roof conditions, and rock splits in the coal in advance of mining.

Geology of the Fluorite Occurrances, Spor Mountain, Juab County, UT, by Kenneth C. Bullock, 1981, 31 p, 15 fig, 2 tables: UGMS Special Studies 53. $3.00 over-the-counter; $3.75 by mail, prepaid. Uraniferous fluorspar deposits occur predominantly as breccia pipes in dolomite at Spor Mountain, in the southwest part of the Thomas Range. The fluorite deposits were first mapped in 1940; in 1953 uranium was discovered on the east side of Spor Mountain, and 1959 the world's largest beryllium deposit was discovered. While the fluorspar appears to be nearly mined out, beryllium mining flourishes and uranium may once again be important.

Oil-Impregnated sandstone deposits, Circle Cliffs Uplift, Utah, by Howard R. Ritzma, 1981, 9 p, 3 fig, tables. $1.00 over-the-counter, $1.75 by mail, prepaid. The Circle Cliffs are 45 miles south-southwest of Hanksville and 20 miles west of the Henry Mountains in Garfield County. The oil-impregnated sandstone deposit contains an estimated 1.3 billion barrels of oil in place, but the area lies partly within Capitol Reef National Park and partly in a proposed wilderness area; water is scarce, and much of the reservoir sandstone is fine-grained and clayey and would present problems in mining and extraction. Ask for UGMS reprint 102.

These publications may be purchased from:

Sales Office
Utah Geological and Mineral Survey
606 Blackhawk Way
Salt Lake City, UT 84108

Note: Utah residents add 5% sales tax.

NEW DIRECTOR

(continued from pg. 1)

Established by law in 1930, the UGMS was first funded in 1941 as a section of State of Utah Publicity and Industrial Development. It was transferred to the University of Utah's College of Mines and Mineral Industries in 1949, and was established as an agency within the State's Department of Natural Resources in 1973.

Today, virtually half of the Survey's geologists inventory the State's geologic resources. Geologists speciallize in petroleum, tar sand, coal, geothermal, salts, metallics, non-metallics, and uranium. Approximately a third of the Survey's geologists identify geologic hazards, describe environmental conditions, or respond to local government requests for help with various geologic engineering problems. The remaining geologists work in education-information or in advisory-administrative capacities.

As the Survey Director, I intend to follow the program initiated by my predecessors, stressing the collection of new geologic information and the dissemination of information already in our files. Although our finances are limited, I intend to reinforce an environment of professionalism at the Survey by increasing staff salaries and benefits (which are at present well below those paid by industry) and maintaining a steady budget balanced between state, federal and other dollars. I believe the Survey will become a more and more active contributor to state policy by making this geologic information available during the early consideration of policy options.

Utah's economic future is bright in large measure because of Utah's geologic resources and for that reason the UGMS' future is bright as well.

LANDSLIDE

(continued from pg. 1)

of the new scarp. A warning was relased by UGMS to local authorities on the prospect for additional earth movement in the vicinity. Another mass, some 700 feet long, did come down on May 19th.

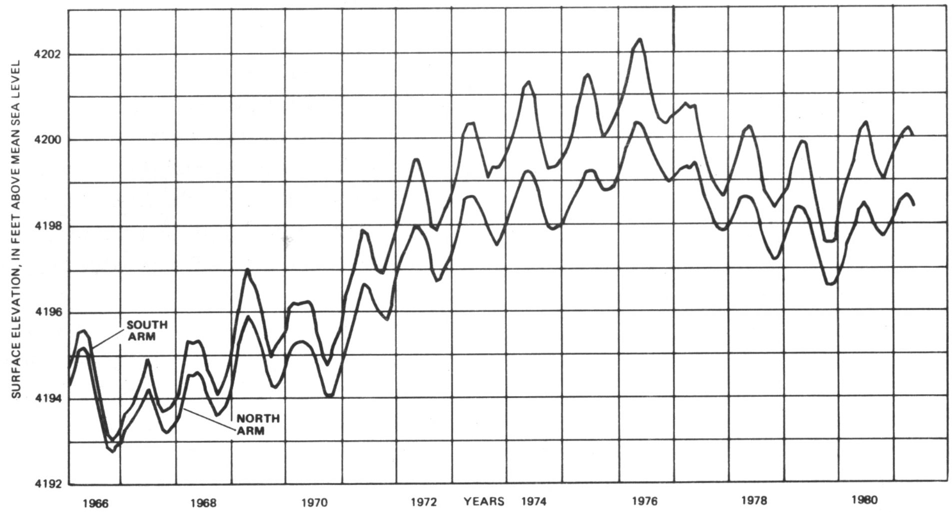
Material involved in the slide was Alpine Formation clay, silt and fine sand of the Pleistocene Lake Bonneville Group. The sediments are thinly laminated and slabs of the unconsolidated materials were strewn over the foot of the slide mass.

The slide mass is stable at this time due to surface grading performed by the Union Pacific Railroad, but the crown of the landslide will continue to calve indefinitely and there is a possibility that additional slope failures will occur along the bluffs east of the present slide.

IN MEMORIAM

Marvin P. Barnes, 54, consulting mining geologist, President of M. Barnes and Associates, Salt Lake City, was killed in the crash of a private plane in the Ruby Mountains, northern Nevada, June 26, 1981.

Victor B. Gras, 60, consulting petroleum geologist, and long-time employee of Mountain Fuel Supply Company (retired), died at his home in Salt Lake City, on July 15, 1981.



Surface elvations of the north and south arms of the Great Salt Lake, calender years 1966-81.

CHANGES IN UGMS STAFF

Genevieve Atwood, geologist and former State legislator, has succeeded Donald McMillan as Director of the UGMS. Ms. Atwood served in the Utah State House of Representatives for seven years, and was a senior geologist and project manager for the consulting firm of Ford, Bacon and Davis Utah, Inc. Her experience includes environmental assessment of radioactive tailings, groundwater hydrology, and geological studies of surface coal mines. She brings valuable administrative skills to the UGMS as well as her experience in dealing with industry, government, and the public.

Mage Yonatoni has been promoted to Library Technician, to replace Lila Reed.

Dave Scardena, Geologic Editor, left to accept a new job as geologic editor in Idaho.

GREAT SALT LAKE LEVELS

DATE	SOUTH ARM	NORTH ARM
May 1	4200.05	4198.65
May 15	4199.95	4198.55
June 1	4200.10	4198.60
June 15	4200.20	4198.60
July 1	4199.95	4198.40
July 15	4199.60	4198.25

Trena Worthington has joined the UGMS editorial staff as a composer operator.

Bonnie Barker, who has been a composer operator in the Editorial Office for over 2 years, is leaving to move to Washington, where she plans to work on a degree in commercial art.

UTAH GEOLOGICAL AND MINERAL SURVEY
SURVEY NOTES

State of Utah . . . . . . .Scott M. Matheson
Govenor

Department of Natural Resources
and Energy. . . . . Temple A Reynolds
Executive Director

Utah Geological and
Mineral Survey . . . . . .Genevieve Atwood
Director

Editor . . . . .Martha Smith
Editorial Staff. . . . . Trena L. Worthington
Chief Illustrator. . . . . Brent R. Jones
Illustrations and
Artwork . . . . Sandra Stewart and
Donald Powers

State of Utah—Department of Natural Resources and Energy
UTAH GEOLOGICAL AND MINERAL SURVEY
606 Black Hawk Way
Salt Lake City, Utah 84108

Address Correction Requested

Account No. 016103
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